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Effect of Annealing in a Magnetic Field on the Preferential Alignment of the Fe-Ni, Fe-Fe, and Ni-Ni Pairs Relative to the Magnetic Field

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We made diffuse scattering measurements on a ferromagnetic material Fe22.5-Ni77.5 permalloy to determine the effect of annealing in a magnetic field on the preferential alignment of the Fe-Ni, Fe-Fe, and Ni-Ni pairs relative to the magnetic field. Prior measurement by others of the magnetic properties for single crystal samples annealed with their [100], [110], and [111] directions parallel to the direction of the applied magnetic field revealed an increasing magnetic anisotropy from the [100] to the [111]. Our measurements confirmed an increasing anisotropy in the alignment of the atomic pairs ascending in the same order as the magnetic properties. Shown in Fig 1 is the (300) short-range order maximum, which is a measure of the number of Fe-Ni pairs aligned, either parallel or perpendicular to the [110] direction of the applied field. Here, we find that the Fe-Ni nearest neighbor pairs have a slight preference to align perpendicular to the field of 3000 Gauss. This accounts for the induced magnetic anisotropy. This was the first verification that magnetic annealing actually changes the number and direction of the pair alignment.

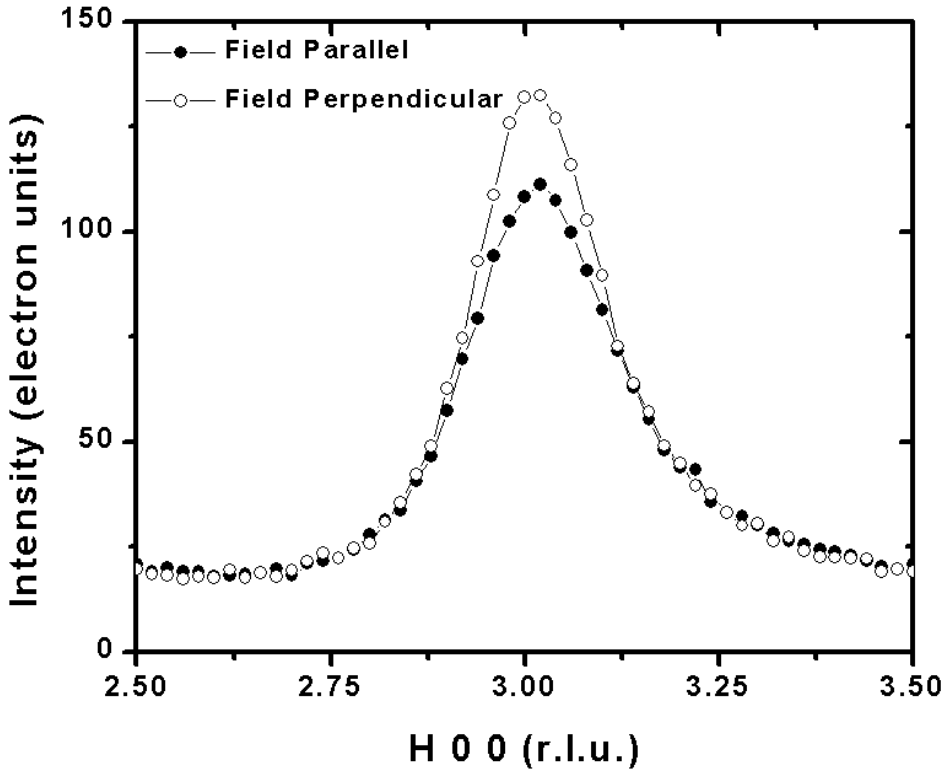

Figure 1. The preference for Fe-Ni first neighbor pairs is slightly enhanced perpendicular to the field direction when annealed at 450°C for four hours in a field of 3000G. This produces an anisotropic magnetic response.